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Hence it will be seen that there is a gradual passage from one type to the other by the disappearance of one character and the appearance of another, certain characters in the meanwhile remaining common, so that there is no sudden break, but an overlapping of structural characteristics. It is, I think, satisfactory to find that, when erupted rocks are examined from such a new and independent point of view, the general conclusions to which I have been led are so completely in accord with those arrived at by other methods of study.

ANATOMY AND PHYSIOLOGY.

The address was delivered by Mr. F. M. Balfour, F.R.S., one of the vice-presidents of the section, who observed that in the spring of the present year Prof. Huxley delivered an address at the Royal Institution, to which he gave the felicitous title of "The Coming of Age of the Origin of Species." It was, as Prof. Huxley pointed out, twenty-one years since Mr. Darwin's great work was published, and the present occasion, Mr. Balfour remarked, was an appropriate one to review the effect which it had had on the progress of biological knowledge. There was, he might venture to say, no department of Biology the growth of which has not been profoundly influenced by the Darwinian theory. When Messrs. Darwin and Wallace first enunciated their views to the scientific world, the facts they brought forward seemed to many naturalists insufficient to substantiate their far-reaching conclusions. Since that time an overwhelming mass of evidence has, however, been rapidly accumulating in their favor. Facts which at first appeared to be opposed to their theories have one by one been shown to afford striking proofs of their truth. There are at the present time but few naturalists who do not accept in the main the Darwinian theory, and even some of those who reject many of Darwin's explanations still accept the fundamental position, that all animals are descended from the common stock. To attempt in the time at his disposal to trace the influence of the Darwinian theory on all the branches of anatomy and physiology would be wholly impossible, and he would confine himself to an attempt to do so for a small section only. There was perhaps no department of Biology which had been so revolutionized by the theory of animal evolution as that of development or Embryology. The reason of this is not far to seek. According to the Darwinian theory, the present order of the organic world has been caused by the action of two laws, known as the laws of heredity and of variation. The law of heredity is familiarly exemplified by the well-known fact that offspring resemble their parents. Not only, however, do the offspring belong to the same species as their parents, but they inherit the individual peculiarities of their parents. It is on this that the breeders of cattle depend, and it is a fact of every-day experience amongst ourselves. A further point with reference to heredity to which he must call their attention was the fact that the characteristics which display themselves at some special period in the life of the parent are acquired by the offspring at a corresponding period. Thus, in many birds the males have a special plumage in the adult state. The male offspring is not, however, born with the adult plumage, but only acquires it when it becomes adult. The law of variation is, in a certain sense, opposed to the law of heredity. It asserts that the resemblance which offspring bear to their parents is never exact. The contradiction between the two laws is only apparent. All variations and modifications in an organism are directly or indirectly due to its environments; that is to say, they are rather produced by some direct influence acting upon the organism itself, or by some more subtle and mysterious action on its parents; and the law of heredity really asserts that the offspring and parent would resemble each other if their environments were the same. Since, however, this is never the case, the offspring always differ to some extent from the parents. Now, according to the law of heredity, every acquired variation tends to be inherited, so that, by a summation of small changes, the animals may come to differ from their parent stock to an indefinite extent. Mr. Balfour then referred to what he spoke of as a concrete example of the application of these two laws, his object being to demonstrate how completely modern embryological naming is dependent on inheritance and varia-

lion, which constitute the keystones of the Darwinian theory. He maintained that "The Origin of Species" afforded explanations of important embryological facts, and added that no explanation, for instance, could be offered of the fact that a frog in the course of its growth has a stage in which it breathes like a fish, and then why it is like a newt with a long tail, which gradually becomes absorbed, and finally disappears. To the Darwinian the explanation of such facts is obvious. The stage when the tadpole breathes by gills is a repetition of the stage when the ancestors of the frog had not advanced in the scale of development beyond a fish, while the newt-like stage implies that the ancestors of the frog were at one time organized very much like the newts of to-day. The explanation of such facts has opened out to the embryologist quite a new series of problems. Having examined these in regard to phylogeny and organogeny, and entering into elaborate scientific details and arguments, Mr. Balfour concluded by remarking that although the present state of our knowledge on the genesis of the nervous system is a great advance on that of a few years ago, there is still much remaining to be done to make it complete. The subject, he urged, was well worth the attention of the morphologist, the physiologist, or even the psychologist, and we must not remain satisfied by filling up the gaps in our knowledge by such hypotheses as he had been compelled to frame. New methods of research will probably be required to grapple with the problems that are still unsolved; but when we look back and survey what has been done in the past, there can be no reason for mistrusting our advance in the future.

RELATION OF VERMONT ARCHÆOLOGY TO THAT OF THE ADJACENT STATES.*

By DR. GEORGE H. PERKINS.

Vermont is a very barren region archæologically as compared with many parts of the West, yet thorough investigation has shown that even there interesting results may be obtained. We not only have found a not inconsiderable number of stone relics, but we have also found, as we think, an interesting relation between these specimens and those from surrounding States. West of the Green Mountains we find our greatest variety of objects, and we find at least two classes, and perhaps more, which should be referred to different people. Here and there, but especially near Lake Champlain, we find objects of copper, and polished stone much more skillfully made than most of the specimens found in New England. In certain graves found near Swanton, and described fully at the Portland meeting of this Association, we find this class of objects. A peculiar form of slate knife (or lance?), polished and with notched haft, is found in Western Vermont, but occurs in greater abundance across the lake in New York and in Central New York. At Palatine Bridge Mr. S. L. Frey has discovered graves of the same kind as those found at Swanton. Taking these finer specimens of ancient workmanship as a basis of comparison, leaving out of account the ruder stone objects and the pottery, we can duplicate most of our Vermont specimens in Central New York, and also we find from Western New York and the mounds of Ohio many which are identical in all essential characters. This is true of shell and copper beads, of copper spear-heads, of stone tubes, axes, gorgets, banner stones and other objects. As we go westward we find these specimens increasing in number and of greater variety, and we also find a few forms absent. These specimens seem to me sufficiently characteristic and numerous to warrant the inference that in them we have a record of a people who emigrated from Ohio through New York, crossed Lake Champlain and reached as far east as the Green Mountains, where they stopped. They also appear not to have reached further north than Northern Vermont, nor further south than the southern end of Lake Champlain.

The other class of relics is composed of ruder objects associated with pottery. So far as I know no pottery has been found with the first class of relics. This pottery is quite unlike that from the mounds or most of that found

* Read before the A. A. A. S., Boston, 1880.

anywhere west of Central New York. The stone implements, and I believe there are none of copper, are ruder and less varied than those first mentioned and are found not only in Western Vermont, but also over the eastern portion of the State and the other New England States. The pottery, occurring chiefly in fragments, is incised and cord-marked and decorated with a great variety of patterns made up of straight lines, circles, &c. This and the stone objects, which seem to be associated with it, appear to be the work of a different and less highly cultivated people than those who made the finer specimens first mentioned, and their makers appear to have lived all over New England and Eastern New York. Thus we have evidence of the former occupation of Western Vermont by a widely spread people, of much skill in the manufacture of stone objects; a people having commenced with those living in the copper region of Lake Superior, and with those living in Florida or some portion of the South, for the shell beads are, some of them, if not all, made from Southern species of mollusks, and also of an ancient, but later occupation by a people of less wide distribution and less development in arts.

THE INDIAN CENSUS.*

Colonel Garrick Mallery, U. S. A., now attached to the Bureau of Ethnology at Washington, discussed last Monday a subject of national interest. On the nine previous occasions when the census of the United States was directed to be taken, the Indians, not taxed, forming a part neither of the voting population nor of any basis of representation, were simply disregarded. The present law provides for the enumeration and the ascertainment of their statistics. This change in legislation may have arisen from the abandonment of the doctrine of necessary extinction, the *fera natura* theory combated by Colonel Mallery at the Nashville meeting of the Association in 1877, and from the probability of the early absorption of many of the Indians into the body of the taxable and voting population, which renders them of future political importance, a factor the effect of which should be estimated. It is also probable that the interest in ethnologic research, noticeable throughout the country, has influenced Congress. General Walker, the able superintendent of the census, has availed himself of an agency that never before existed. The Bureau of Ethnology, lately established by act of Congress and now under the direction of Major Powell, was entrusted with the whole of the duty in question. Without the preparation already made by the Bureau of Ethnology the work could not be done accurately, and by scientific methods. It might possibly have fallen into the hands of mere office seekers, perhaps of persons interested in the concealment if not perpetration of frauds. The enumeration of the Indians is difficult. Though restrained more or less successfully within specified limits, they are still apt to range over large regions, and to be away, for long periods from the place of their compulsory or voluntary habitation. This is especially the case in Summer, and the day of June fixed for the general census being inappropriate, the first day of October was selected instead. There are other causes interfering with accuracy. If fraud is attempted it is assisted by an enlarged paper-number of recipients of rations, and the Indians themselves are tempted to swell their lists, both for rations and annuities. Hostile or troublesome bands, under differing circumstances, seek to exaggerate or conceal their military strength. The aboriginal reluctance of each person to give his own name, and of all to speak of deceased relatives and friends is well known. These and many other obstacles require that the duty shall be in charge of persons familiar with the Indian customs, who both know what to look for and how to find it. The forms and schedules of the general census being wholly inapplicable, others have been prepared with great care. They are five in number. 1. *Population*. Each sheet is confined to one family in one dwelling, that unit being of much greater importance in savage and barbaric than in civilized life. The location of the dwelling is given by legal and natural subdivisions, also its description; if a house, whether of brick, stone, adobe, frame or log; if pueblo, whether stone or adobe; if lodge,

whether of cloth, skins, slabs, poles, brush, bark, tule, stone or earth. The head of the family, often a woman, is first designated, and the relationship of each person to that head. For each individual the Indian name is given, with the English translation of that name; also the English, Spanish, French or other name habitually used. This serves not merely for identification, but brings out the names originally designated on the system of the *gens* organization, and also the title or sobriquet generally bestowed in after-life from some achievement or circumstance often of sociologic, if not historic, interest. Mixture of blood between several tribes, and between Indians and whites and negroes, is noted, and all matters relating to advance in civilization, such as wearing citizen's dress, amount and kind of personal and real property ownership, in which is recognized cultivation of land and sources of subsistence. 2. The schedule for *vital statistics* inquires into the causes of deaths during the past year, and the prevalence of the diseases to which Indians are subject; among other interesting points obtaining in the Indian tongue a statement from the head of the family, or medicine man, of the cause of death, thus showing the aboriginal theories of diseases. 3. *Industries*, embraces every appropriate particular under that head, classified for full and mixed bloods, and adopted whites and negroes, all by tribes instead of by families and individuals, as in the "population" schedule, and with details more useful for statistical purposes. 4. *Education*, is on the same principle. Schedule 5 guides and simplifies research into the wondrous system of ramified consanguinities and affinities, on which savage society is founded and depends. The work of the present census of the Indians will be of great practical value. It will correct some popular errors which have obstructed judicious legislation, confused statesmanship and misled philanthropy, and will render frauds difficult of perpetration. The schedules also show that advantage has been taken of this opportunity to lead research into points of deep scientific interest.

EXPERIMENTS ON THE STRENGTH OF YELLOW PINE.*

By PROF. R. H. THURSTON.

The elasticity of yellow pine timber as used in construction is very variable, the modulus varying from one to three millions, the average being about two millions in small sections, and a little above one and a half millions in large timber.

The highest values are as often given by green as by seasoned timber, and that, under sixteen square inches section and fifty-four inches length, at least, the magnitude of the modulus of elasticity is independent of the size of the piece.

The density of the wood does not determine the modulus; since the figure varies sometimes directly and sometimes inversely with the density, even where the wood is as nearly as possible in the same condition as to seasoning.

A high modulus usually accompanies high tenacity and great transverse strength, but it is not invariably the fact that maximum ultimate strength is accompanied by initial stiffness.

The pseudo moduli, determined by taking considerable deflections, are usually not greatly different from those determined from small deflections and light loads. The values of these moduli often decrease with increase in deflection.

An inspection of the woods tested plainly indicates, in the opinion of the writer, that the density of the pines is so considerably modified by the amount of pitch contained in the sap channels that it cannot be regarded as indicative of the strength of the timber. Where quite free from sap the wood usually exhibits increase of strength and elastic resistance to deflection, with increase of density.

The strength of timber, otherwise similar, is greatly affected by its structure, and the resistance offered to stresses applied transversely is greatest when the sections

*Read before the A. A. A. S., Bo

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